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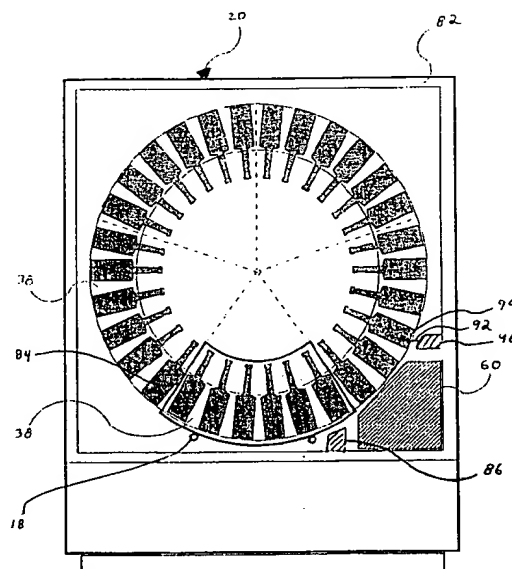
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(54) **Sub-compact blood culture apparatus**

(57) The present invention describes an apparatus for detecting biological activities in a large number of blood culture vials. The vials are placed in a plurality of arcuate shaped drawers that together form a drum that is rotated about a central horizontal axis. In one preferred embodiment, the apparatus includes five drawers with each drawer containing forty-eight vials. The apparatus includes a door on the front that opens and permits the lower drawer to be removed from the apparatus by lab personnel to load the entire drawer with up to forty-eight vials and unload the same when necessary from the top of the drawer. Another embodiment has an indicator associated with each vial in the drawer to provide additional information to lab personnel about the status of each vial in the drawer.

FIG. 2



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incorporates individual vial identification and the application of more than one microorganisms detection method within a single instrument. The apparatus provides low system sensitivity variations from one vial station to the next and does not require electronic or optoelectronic components, electrical wires, or optical fibers on a moving dial rack. As a result of these several advantages, it provides long-term reliability during operation.

In addition, the present invention allows lab personnel to grasp each vial at its neck during loading and unloading, offers simultaneous access to a large number of vials during loading and unloading, and also has a smaller footprint as compared to existing blood culture systems without any increase in height.

According to the present invention, a culture medium and blood specimen are introduced into sealable glass vials containing optical sensing means and having a bar code pattern for individual vial identification associated thereto. A large number of such vials are arranged radially on a rotatable drum within an incubator, which is used to promote microorganism growth. Sensor stations are mounted to the mainframe of the blood culture apparatus at such a distance from the drum that, during its rotation, each individual vial passes over a sensor station.

In a first embodiment of an apparatus according to the present invention, the vials are arranged radially on a rotatable drum within an incubator. The shaft or axis of the rotatable drum is oriented horizontally and perpendicular to the front face of the incubator. To load and unload each vial into and out of the drum, the front face of the incubator has a door in its lower area. A preferred arrangement of the vials on the drum is to group the vials using disk-like segments around the axis in a number of equal subdivisions that carry arcuate shaped drawers with openings for the vials.

Each disk-like segment or drawer is mounted on rails that are oriented parallel to the drum's axis. During the loading and unloading operations, the drum is rotated until one drawer is located at the door in the incubator's front face. The drum is then stopped, the door opened, and the corresponding drawer of vials is moved through the door out of the incubator on the rails. For example, if the drum contains eight disk-like segments of thirty vials each and is segmented into five subdivisions, then one drawer would contain 48 openings to accepted 48 blood culture vials. Each of the vials are loaded and unloaded in an upright orientation from the top of the drawer, since the door is located in the lower drum area. Of course, to access the remaining vial drawers, the first drawer is moved back into the incubator on the rails, the door is closed, the drum is rotated through an angle of 72°, the door is

again opened, and the next drawer is moved out of the incubator on the rails.

Another embodiment of the present invention uses only three automated drawers having 80 vial stations therein. Therefore, it is easier for lab personnel to load and unload the apparatus since the user has access to 80 vial stations, simultaneously, and the whole loading and/or unloading operation requires only three steps.

These and other aspects, features and advantages of the present invention will become apparent from the following detailed description, taken in conjunction with the accompanying drawings.

## DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a side view of the interior of a sub-compact blood culture apparatus for the detection of microorganisms according to the present invention, with an embodiment comprising eight disk-like drum segments with thirty vials in each segment;

Fig. 2 shows a cross-sectional front view of the apparatus shown in Fig. 1;

Fig. 3 shows a full front view of the apparatus shown in Figs. 1 and 2;

Fig. 4 shows a perspective view of the 240-vial blood culture apparatus shown in Fig. 1, according to the present invention, in comparison to an existing 240-vial blood culture apparatus (BACTEC 9240® Blood Culturing System, currently sold by Becton Dickinson and Company);

Fig. 5 shows an alternative embodiment of a sub-compact blood culture apparatus according to the present invention with a lower automated drawer having 48 LED's as illumination sources for 48 load/unload indicators;

Fig. 6 shows a file drawer in the apparatus shown in Fig. 5;

Fig. 7 shows a cross-sectional front view of another embodiment of a sub-compact blood culture apparatus, having a drum with three drawers; and

Fig. 8 shows a full front view of the apparatus shown in Fig. 7.

## DETAILED DESCRIPTION

A sub-compact blood culture apparatus 20 embodying the principles and concepts of the present invention is depicted schematically in Fig. 1. Apparatus 20 comprises a drum 40 containing a plurality of glass vials 22, each sealed with a septum 24 and containing a medium/blood mixture 26. Each vial 22 contains a fluorescence chemical sensor 28 disposed on an inner bottom surface 30, and a bar code label (not shown) positioned on bottom surface 30.

system and apparatus 20 of the present invention and, more particularly, shows the length of apparatus 20 to be 30 inches, which is smaller than the length of the currently available BACTEC 9240® system that is 51 inches. The present invention, therefore, reduces the overall footprint but still cultures two hundred and forty vials 22.

Fig. 5 shows another embodiment of a blood culture apparatus 70 according to the present invention, with components similar to components in apparatus 20 represented by the same numerals. Blood culture apparatus 70 includes an additional lower drawer 80 with forty-eight LED's 79 as illumination sources serving as load/unload indicators that indicate whether a corresponding vial contains bacteria or not. Lower drawer 80 moves together with upper automated drawer 78 out of door 84 in incubator 82 during loading/unloading operations.

Fig. 6 shows a top view of vial drawer 78 as it moves through door 84 out of incubator 82. As shown in Fig. 6, each vial station 100 is equipped with a plastic light guide 105 that can be illuminated from below by a corresponding LED 79. A steady-state light 79 is used to indicate that station 100 is ready for loading. Accordingly, a flashing light 79 is used to indicate that station 100 should be unloaded. In addition, a low flashing frequency may be used to indicate that vial 22 does not have bacterial growth therein and a much higher flashing rate may be used to indicate that vial 22 is positive.

Fig. 7 shows yet another embodiment of a blood culture apparatus 200 having three drawers 238. Each drawer 238 containing eighty openings 250 for holding eighty vials 22 in a matrix consisting of ten rows and eight columns. As in the other embodiments, each drawer 238 is capable of being loaded and unloaded through door 84. Fig. 8 shows a full front view of apparatus 200 and more clearly shows door 84 and loaded drawer 238.

In the foregoing discussion, it is to be understood that the above-described embodiments are simply illustrative of a preferred apparatus for practicing the present invention, and that other suitable variations and modifications could be made to these embodiments and still remain within the scope of the present invention.

## Claims

1. A sub-compact blood culture apparatus comprising:

a drum rotatable about a horizontal axis having a plurality of drawers, each of said plurality of drawers including a plurality of openings in a top surface for receiving a plurality of vials;

a mechanism for rotating said drum about said axis;

at least one sensor station for detecting microorganisms within the plurality of vials received within said drum;

means for determining when one of said plurality of drawers is at a predetermined removal position; and

means for removing said drawer at said predetermined removal position out of said drum so that said plurality of vials may be loaded into and unloaded from said plurality of openings in said top surface of said removed drawer.

2. A sub-compact blood culture apparatus according to Claim 1, wherein:

each of said plurality of vials have a base and a neck; and

said removed drawer is loaded with said base of each vial within said removed drawer and said neck of each vial extending from said top surface, so that said neck is closest to the axis of said drum when said removed drum is returned to said drum.

3. A sub-compact blood culture apparatus according to Claim 1, wherein said removing means comprises a pair of rails upon which said removed drawer slides during removal from said drum

4. A sub-compact blood culture apparatus according to Claim 3, further comprising a door at said predetermined removal position for sealing said apparatus when in use and opening to permit said removed drawer to slide on said pair of rails for removal from said drum.

5. A sub-compact blood culture apparatus according to Claim 1, further comprising an additional lower drawer with a number of illumination sources serving as load/unload indicators that indicate whether a corresponding vial is positive or not, and where said lower drawer moves together with the corresponding upper drawer during loading/unloading.

6. A sub-compact blood culture apparatus according to Claim 5, wherein each illumination source indicates whether its corresponding opening contains one of said plurality of vials.

7. A sub-compact blood culture apparatus according to Claim 1, wherein said drum includes three arcuate shaped drawers.

8. A sub-compact blood culture apparatus according to Claim 7, wherein each of said arcuate shaped drawers includes a matrix of said

FIG. 1

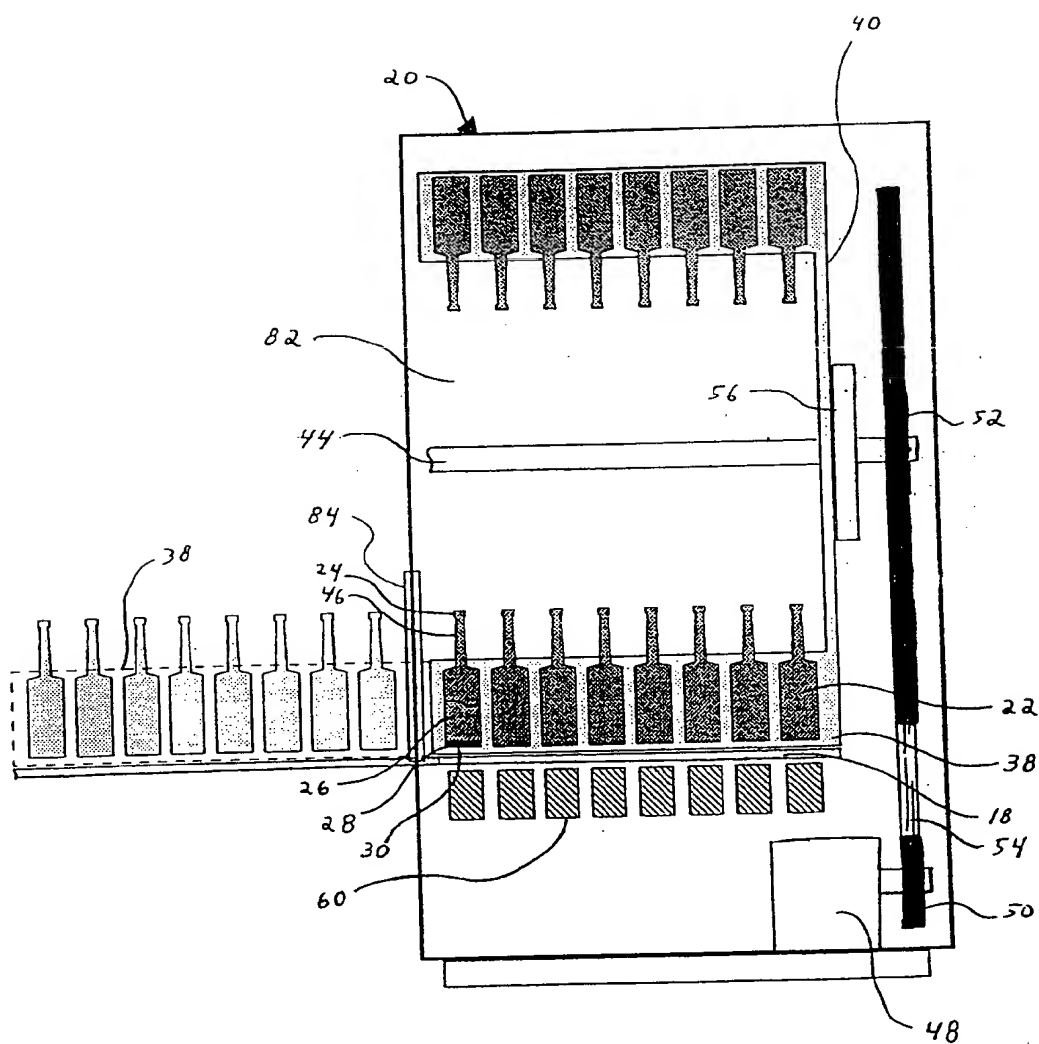


FIG. 3

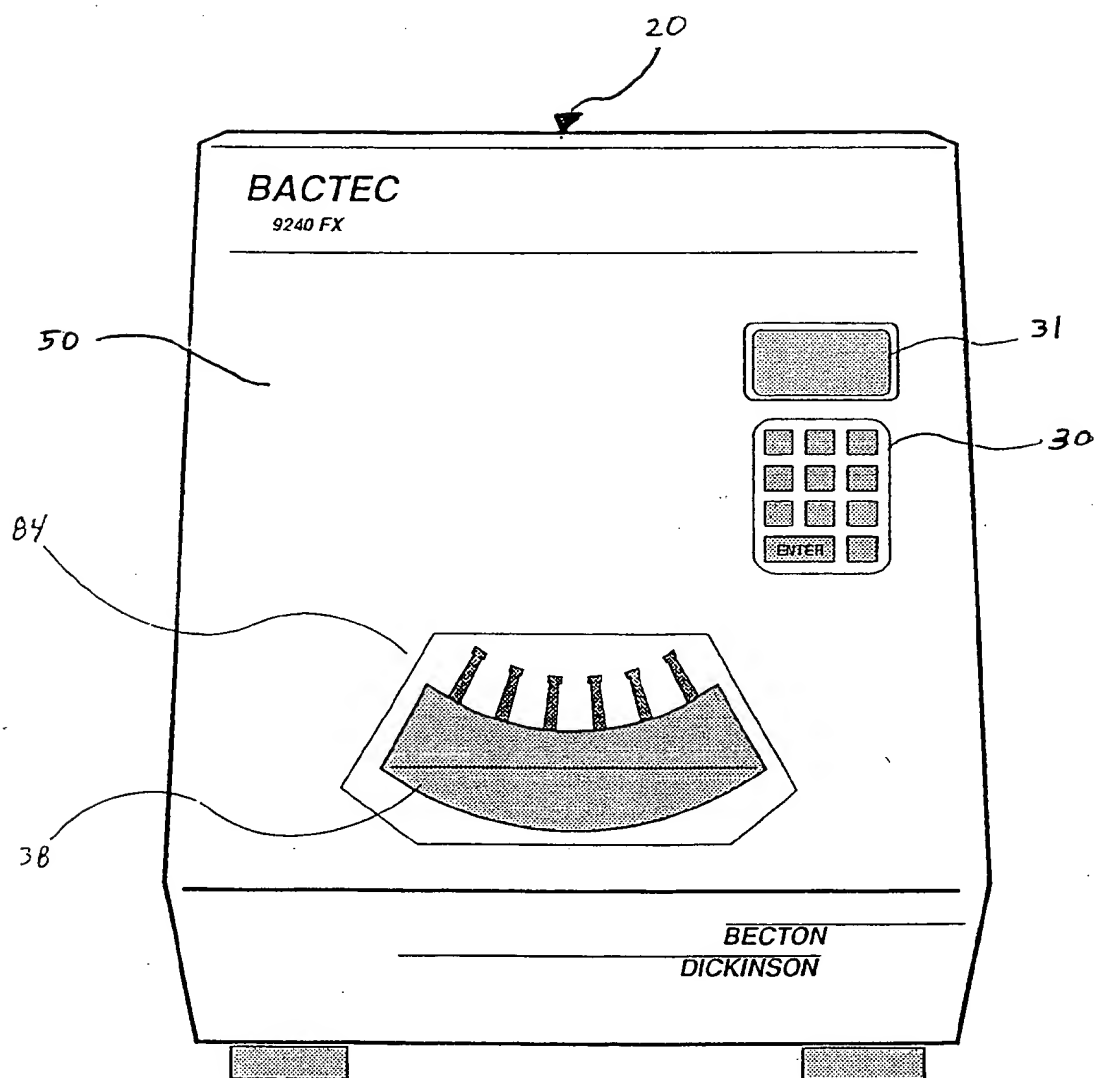


FIG. 5

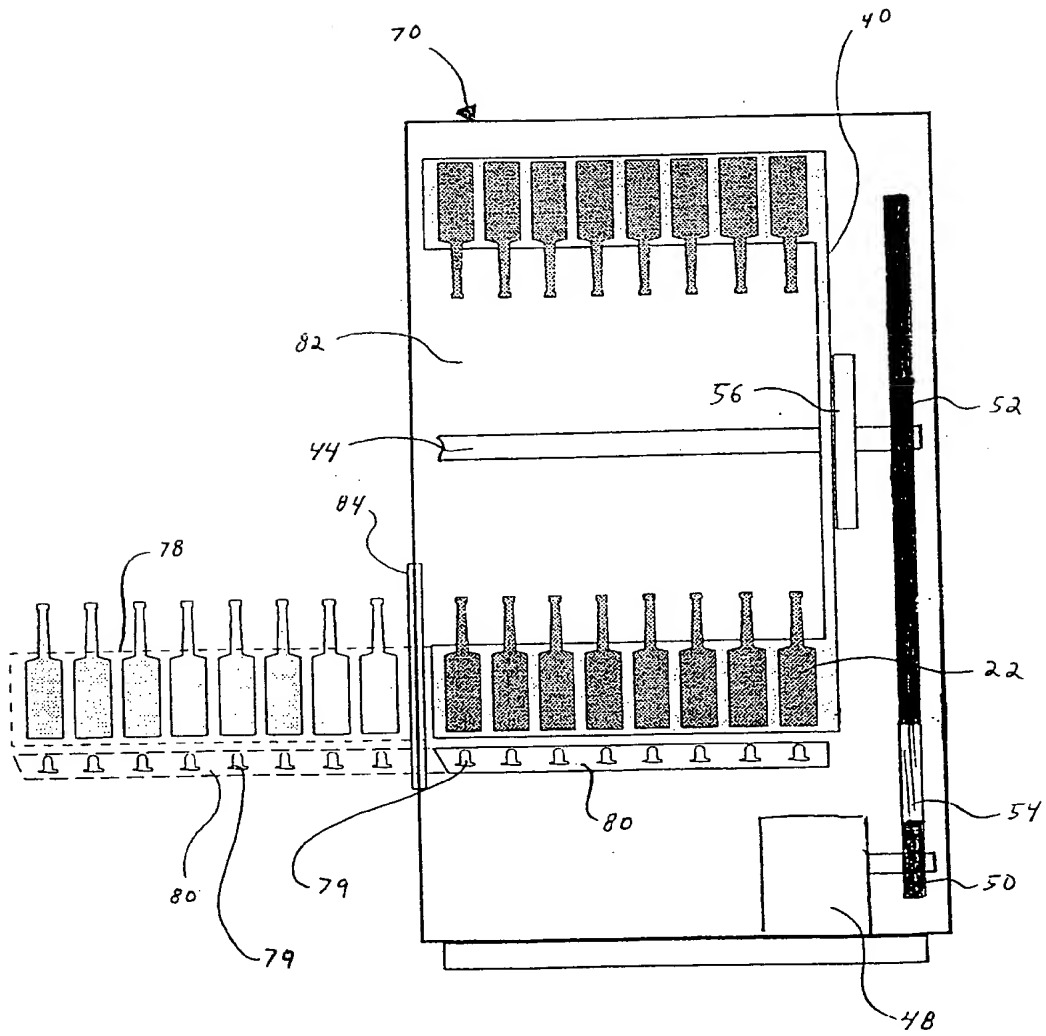
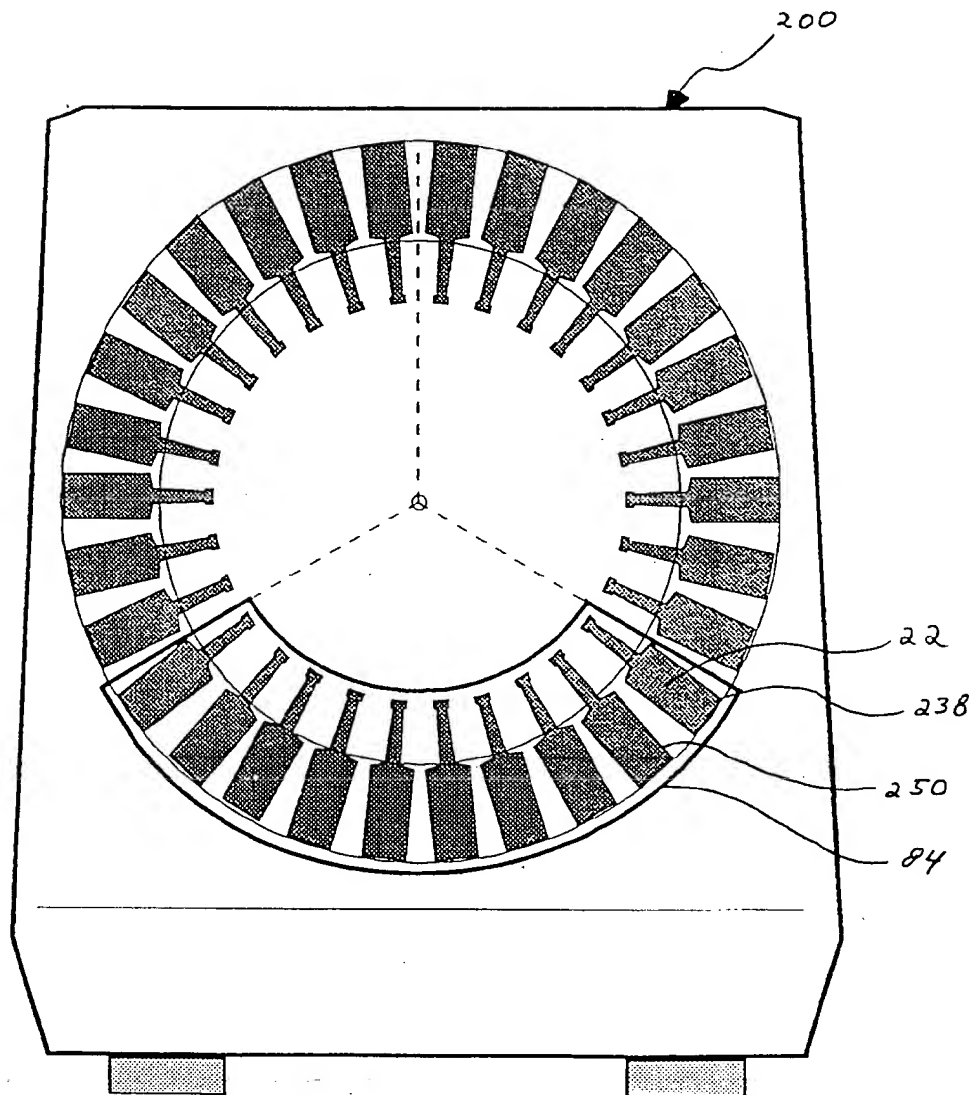



FIG. 7



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FIG. 2

